

REQUEST FOR RECONSIDERATION

Claims 1, 3-8, 10, 16 and 17 are pending in this patent application and stand rejected. Claim 1 has been amended and Claims 16-17 have been canceled. Applicants believe all previously pending claims are allowable over the prior art of record. These amendments are not considered necessary for patentability. In view of the foregoing amendments and the following remarks, Applicants respectfully request reconsideration and favorable action in this Application including an indication of the allowable nature of all pending claims.

REMARKS

Rejections under 35 U.S.C. § 103

Claims 1, 3-8, 10, and 16-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,627,486 to Ohtani, et al. ("Ohtani"), in view of U.S. Patent No. 4,908,334 to Zuhr, et al. ("Zuhr"). Applicants respectfully traverse these rejections for the reasons discussed below.

Independent Claim 1, as amended, recites:

A method of fabricating a semiconductor device including a crystallized active layer comprising the steps of:

providing a substrate;

depositing an amorphous silicon layer on said substrate;

depositing a metal layer of Ni or Pd for inducing low temperature crystallization of amorphous silicon on at least a portion of said amorphous silicon layer by sputtering while heating said substrate to a temperature that allows at least a portion of the deposited metal to react with the amorphous silicon to form an oxidation-stable metal silicide film; and

conducting a thermal treatment of said substrate so that said amorphous silicon layer is crystallized by metal induced lateral crystallization (MILC) propagating from the portion covered by said metal layer.

Applicants respectfully submit that the Examiner has not shown a *prima facie* case of obviousness because neither *Ohtani* nor *Zuhr*, alone or in combination, teaches or suggests all the claim limitations of independent Claim 1. For example, neither *Ohtani* nor *Zuhr* teaches or suggests "depositing a metal layer of Ni or Pd for inducing low temperature crystallization of amorphous silicon on at least a portion of said amorphous silicon layer by sputtering while

heating said substrate to a temperature that allows at least a portion of the deposited metal to react with the amorphous silicon to form an oxidation-stable metal silicide film," as recited in amended Claim 1.

First, the Examiner acknowledges that *Ohtani* does not expressly disclose "sputtering while heating said substrate to a temperature that allows at least a portion of the deposited metal to react with the amorphous silicon to form an oxidation-stable metal silicide film." (Office Action, page 3). Instead, the Examiner relies on *Zuhr* for disclosure of this limitation. However, *Zuhr* merely discloses the formation of metallic silicide films on the surface of heated silicon substrates by ion beam deposition "maintained at a relatively low energy level so as to inhibit losses by sputtering and to prevent the penetration of the ions into the substrate beyond a distance of only a few monolayers." (*Zuhr*, col. 2, lines 49-58). "The silicon substrate is heated during the contacting thereof with the metal ions to a temperature sufficient to effect diffusion of silicon atoms from the substrate to contact the metal ions as they are being deposited on the surface of the substrate or any portion of the metallic silicide film subsequently formed thereon to essentially athermally interact therewith for continuously forming a film of stoichiometric m metallic silicide on the surface of the silicon substrate." (*Id.*, col. 2, lines 15-24). "Since the penetration depth of the ions into the substrate is small as required for a surface technique, then at the relatively low temperatures used herein, the reaction will stop after the silicide grows sufficiently thick (in the order of several monolayers) to isolate the silicon substrate from the newly arriving atoms." (*Id.*, col. 4, lines 4-10). Thus, the method for forming a metallic silicide film disclosed in *Zuhr* is limited to a method of manufacturing for diminishing the diffusion of ions into the substrate. In addition, the metallic silicide in *Zuhr* is formed on single crystal silicon or polycrystalline silicon, (col. 3, lines 32-41) and nowhere is it disclosed that amorphous silicon is utilized. Accordingly, *Zuhr* does not teach or suggest "while heating said substrate to a temperature that allows at least a portion of the deposited metal to react with the amorphous silicon to form an oxidation-stable metal silicide film," as recited in amended Claim 1.

Therefore, neither *Ohtani* nor *Zuhr* teaches or suggests each and every limitation of independent Claim 1. Thus, a *prima facie* case of obviousness has not been established and Claim 1 is allowable. Reconsideration and favorable action are respectfully requested.

Applicants also submit that the Examiner has not shown a *prima facie* case of obviousness because the Examiner has not cited language in either reference or within information commonly known to those skilled in the art that provides the necessary motivation or suggestion to combine *Ohtani* and *Zuhr*. *Ohtani* is directed towards "crystallizing an amorphous silicon film formed on a substrate by employing lateral growth method using a catalyst element which accelerates the crystallization . . ." (*Ohtani*, abstract). Thus, a metal is added to the surface of the amorphous silicon and the structure is crystallized by annealing with the metal as the catalyst element. *Ohtani* discloses that transition metal elements that may be used "include nickel, platinum, palladium, copper, silver, and iron." (*Id.*, col. 1, lines 65-67). In contrast and as discussed above, *Zuhr* discloses a method for forming a metallic silicide by diminishing the diffusion of ions into the substrate. The metallic silicide films are formed for metal-silicon systems in which silicon is the dominant diffusing element, i.e., the metal atom is less mobile in the silicide. (*Zuhr*, col. 3, lines 42-45) Thus, it is required that metals that "are slower diffusers or less mobile in metallic silicides than the silicon atoms" be utilized, such as "titanium, tungsten, iron, vanadium, tantalum, and molybdenum." (*Id.*, col. 4, lines 37-46). By requiring metals that are slow diffusers, *Zuhr* teaches away from teachings of *Ohtani*. For at least these reasons, one of ordinary skill in the art at the time of the invention would not have been motivated to combine the method for forming a crystalline semiconductor film with a metal catalyst disclosed in *Ohtani* with the method for slowing diffusion of metal ions disclosed in *Zuhr*. In addition, since the metals used by *Zuhr* to form silicide have lower diffusion rates than silicon, they may not be used to induce crystallization of amorphous silicon, as in *Ohtani*. Accordingly, if the technique taught by *Zuhr* were applied to *Ohtani*, the method taught by *Ohtani* would be unsatisfactory for its intended purpose, which is not allowed. (See MPEP § 2143.01).

Therefore, the required motivation or suggestion to combine *Ohtani* and *Zuhr* has not been shown and, for this additional reason, a *prima facie* case of obviousness has not been established and Claim 1 is allowable. Reconsideration and favorable action are respectfully requested.

Dependent Claims 2-8 and 10 are also not rendered obvious by *Ohtani* in view of *Zuhr* because they include the limitations of independent Claim 1 as well as further

limitations that further distinguish *Ohtani* and *Zuhr*. Therefore, *Ohtani* and *Zuhr* do not render obvious Claims 2-8 and 10. Reconsideration and favorable action are respectfully requested.

In addition to depending from allowable independent Claim 1, dependent Claim 3 is also allowable for the following reasons. Claim 3 recites that "the substrate is heated at a temperature in a range of 200-700°C." As discussed above, the Examiner acknowledges that *Ohtani* does not teach heating the substrate while depositing a metal layer. (Office Action, page 3). In addition, *Zuhr* discloses that "[i]t has been found that for the formation of stoichiometric metallic silicide films with a thickness in the aforementioned range [1 to 300 nm] that heating the silicon substrate to the temperature in the range of about 400° to 600°C is required." (col. 4, lines 17-21). Heating the temperature less than about 400°C provides "an insufficient concentration of silicon atoms to produce a uniformly stoichiometric silicide throughout the film thickness. Also with temperatures greater than about 600°C no beneficial increase in the diffusion of silicon atoms is realized and deleterious diffusion and/or volatilization of the dopants from the substrate starts to occur and increases with increasing temperature." (col. 4, lines 21-30). Thus, *Zuhr* specifically teaches away from heating the substrate to "a temperature in a range of 200-700°C," as recited in dependent Claim 3. For this additional reason, Applicants respectfully request reconsideration and allowance of Claim 3.

CONCLUSION

Applicants respectfully submit that this Application is in condition for allowance and favorable notice thereof is requested. If there are any matters that can be discussed by telephone to further the prosecution of this Application, Applicants invite the Examiner to call the undersigned attorney at the number below at the Examiner's convenience.

A check in the amount of \$475.00 is enclosed to cover the cost of a three-month extension of time. Although Applicants believe no other fees are due, the Commissioner is hereby authorized to charge any fees or credit any overpayments to Deposit Account No. 02-0384 of Baker Botts L.L.P.

Respectfully submitted,

BAKER BOTTS L.L.P.
Attorneys for Applicants



Thomas A. Beaton
Reg. No. 46,543

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CORRESPONDENCE ADDRESS:

Baker Botts L.L.P.
2001 Ross Avenue, Suite 600
Dallas, Texas 75201-2980
Phone: 214.953.6464
Fax: 214.661.4464

Customer Number: **05073**